The UK rail sector is facing a number of major challenges after a tumultuous year: falling performance; poor customer satisfaction; a network at capacity; and ongoing difficulties in delivering enhancements while maintaining current operations. There are calls from some quarters for ‘nationalisation’ and the Secretary of State has commissioned a comprehensive review of franchising in particular and the industry in general.

Amey has a unique perspective of the industry - as a consultant, as an engineering contractor, and more recently as an operator of services. We believe a great deal has been achieved over the past 25 years (not least a doubling in passenger numbers and record levels of safety) but that further, significant change is now required.

One such change is the closer integration of train operations with infrastructure management, in order that a ‘whole systems’ approach can be better adopted to some of the challenges. Such integration has the potential to generate major operational efficiencies and passenger benefits. We also support current moves to devolution of management and operational responsibilities, and would further suggest that such devolution should also support closer integration of regional social and economic policies with transport sector goals. This supplement explores some of these issues and, we hope, contributes to the current debate within the industry.

Welcome

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BRINGING TRACK AND TRAIN CLOSER TOGETHER

Amey’s Consulting and Rail Development Director MARK BROWN tells RAIL why greater devolution and the closer integration of train and infrastructure operations should form the basis of future franchising

Amey’s Consulting and Rail Development Director MARK BROWN tells RAIL why greater devolution and the closer integration of train and infrastructure operations should form the basis of future franchising.
for the past 20 years, significant progress has been made in understanding how the physical assets that make up our transport infrastructure behave over their lifecycles, and how infrastructure managers like Network Rail can get the most from them.

Clearly, having improved engineering knowledge is useful from an asset management knowledge is useful from an asset management and operations, by using a bridge between these two distinct worlds of tangible benefits for transport operators and management and whole-life-cost point of view. Network Rail can get the most from them.

Meanwhile, understanding how the assets themselves deliver safe, reliable and modally integrated journeys will become increasingly relevant as connected autonomous vehicles begin appearing on our roads.

In rail, the company has spent almost two years adopting this end-to-end approach with Network Rail’s South East route in order to develop a deep and data-driven understanding of how conflicting and congested timetables interact with one another.

Connecting London with Kent, Surrey, Sussex and the continent, the South East route is NR’s busiest and most congested in the country, with around 5,000 trains running each day over 2,000 miles of track.

By taking a fresh and holistic view of asset management, operational management, train and station operation, and organisational processes and business cultures across the route, Amey Strategic Consulting began to piece together how data that was already being generated by NR could be used to improve performance. It found that timetables were being produced based on assumptions regarding the time taken for trains to load and unload passengers, and to move between stations. However, staff responsible for implementing those timetables including drivers, station staff and signallers - rarely had visibility on how trains were actually performing against those metrics, and in which areas time was frequently being lost.

By taking live train movement data and presenting it in a meaningful way to staff at all levels, Amey Strategic Consulting was able to provide the Network Rail Route team and staff employed by its primary train operating customers (Thameslink Gavia Railway and SouthEastern) with a more tangible understanding of their performance against their individual responsibilities, and also help them identify where there was room for improvement - for example, more closely matching staffing levels with demand at different times of the day.

Jarritt explains: “We worked with NR on a busy part of the network that has lots of performance issues, to try and unpick them. NR already had the ability to monitor every single train, but as an industry we’d never tried to draw that into one place and then ask what it meant in terms of our strategic planning assumptions.

“With the number of people now using the railway and the sheer lack of capacity that now hampers it, we are being asked to solve problems at a level of complexity that never used to exist. It’s a huge challenge which requires a new approach, but we believe in using data science and analytics to turn that into action as one of the key vectors to meet this challenge.

“We’ve found that once you have discovered patterns then you can try and solve the problem - we don’t see many other people in the industry thinking like that and talking about both infrastructure and operations together, in a fragmented industry that has lots of contractual boundaries and is a difficult space to change.

With that project now at an end, Amey Strategic Consulting has helped NR to employ its own data analysis staff while working with senior management to develop this new capability, and to further integrate it within the complex structure of the rail industry in order to continue to drive for further performance improvements.

According to Amey Strategic Consulting Project Director Ian Gordon, the changes made within NR and its TOC customers are as much cultural as they are technical, by making individuals at all levels understand how they can utilise the information provided to them to establish their own performance, contribute to the bigger picture and deliver better outcomes for passengers.

He says: “It’s one thing to make data accessible to people in an organisation, such as regression models, which you can then turn into a dashboard, but it usually only goes to executive staff.

“In order to change something as fundamental as the timetable you have to provide that information to people who might not even have an internet-connected device, so you can make them understand how they contribute to the running of the wider organisation and therefore make a difference.”

Jarritt adds: “In the South East there were three different operators which didn’t quite fit together and, even with very skilled data analysts, it took a long time to analyse anything.

“IT’s not realistic to say that artificial intelligence and data will be the silver bullets to solving everything, but we have shown that you can educate people in more effective ways to act, and that the network requires support from lots of different people.”

Following the commencement of the Wales & Borders franchise last October by a KeolisAmey joint venture, Amey Strategic Consulting now finds itself consulting internally with other parts of the Amey Group to help support the delivery of the contract.

Combining the asset and operational spaces has particular relevance to this franchise, which requires KeolisAmey to not only operate main line services throughout Wales, but to maintain infrastructure on the Valleys Lines that has recently been transferred from NR to devolved transport authority Transport for Wales.

With services running close to capacity and ageing infrastructure and rolling stock in urgent need of investment, KeolisAmey is charged with improving performance in the short term while plans are developed for the construction of a £5 billion South Wales Metro, due to open in 2023.

But despite the scale of the challenge, Jarritt is confident that the holistic data-driven approach honed on NR’s South East route can be deployed throughout Wales to transform the passenger experience.

“Wales is a different beast (to the South East) really, it’s still at an early stage.

“Although we’re working with Transport for Wales, we’re very far from being ready for anything. KeolisAmey are confident that we can make a big difference, which is good for Wales but also Amey as a whole, because we are willing to hold ourselves to account, as well as providing consultancy externally.”

"We’re deeply embedded in a big and difficult contract, but we want to tackle the hardest problems as they are also the opportunities for making the biggest change."

Jon Jarritt, Partner, Amey Strategic Consulting
Paul Stephen looks at how Internet of Things (IoT) technology is being used to create a potential solution to the infuriating problem of bridge strikes by tall road vehicles

On January 15, Network Rail reported that both it and Leicestershire County Council had been forced to close Kettering Road in Market Harborough after a bridge carrying the Midland Main Line was struck by a lorry. With approximately 2,000 such “bridge strikes” recorded across the network each year (at an average rate of more than five a day), this unfortunate incidence of driver negligence is an all-too-familiar tale of woe. But what made events in Market Harborough all the more remarkable is that engineers had completed repairs to brickwork only minutes earlier, following a separate kerry collision the previous night.

Both incidents had occurred despite the presence of large fluorescent markings and signs clearly indicating the height restriction ahead, and regardless of the HGV drivers’ legal responsibility to know the heights of the vehicles involved.

Each bridge strike delays freight and passenger trains by two hours while checks are carried out. The average cost to NR is estimated at around £131,000 (about £33 million a year) to carry out repairs and to compensate train operating companies.

The true annual cost to the economy of bridge strikes is much harder to quantify, and regardless of the HGV drivers’ legal responsibility to know the heights of the vehicles involved.

Further stages of NR’s campaign involved heavy engagement with some of the UK’s largest hauliers (including Wincanton and Eddie Stobart), bus operators and trade bodies such as the Road Haulage Association, to ensure that relevant training and support to drivers is made a higher priority.

The campaign was then re-launched last August with drivers encouraged to ‘rise up and size up’ and to use newly compiled information and resources, provided for free on the NR website to support driver training, and help spread the message.

Speaking to RAIL in December 2017 (RAIL 842), NR’s senior engineer and London North Western route bridge strike champion Mark Wheel said the campaign would also be accompanied by a call for much stricter enforcement of penalties for drivers when strikes happen, in order to create a more effective deterrent.

He said: “Historically, there has been a reluctance to prosecute drivers for careless driving and their failure to comply with road traffic signs. We’re not quite sure why, but we’re working very closely with police, the Home Office and Driver and Vehicle Standards Agency and traffic commissioners to toughen up on enforcement.

“There is no panacea for bridge strike prevention, but it’s about achieving incremental changes in behaviour which will build up over time. This campaign is not a one-hit wonder, and it will now feature in our national campaign schedule alongside the regular work we do to tackle trespass during the school holidays and suicide prevention.

“Promoting bridge strike prevention can be summed up very easily by the ‘Four Es’ – Education, Engineering, Enablement and Enforcement.”

Mark Wheel, Senior Engineer and Route Bridge Strike Champion, London North Western

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Also accompanying the campaign are NR’s more longstanding efforts to identify

High frequency sites where it can increase headroom or install steel beams to limit damage to infrastructure.

Better still, bridges such as the notorious Stony Stratford Bridge are already undergoing upgrades to take strain without any intervention from the driver.

Route planning tools are also high on NR’s agenda in response to an illuminating report published by standards body RSSB in 2012 into the causes of strikes.

Entitled Reducing the number and impact of vehicle strikes on railway underbridges, the report’s author Michael Woods found that part of the problem was drivers using cheap satnav devices, instead of specialist systems designed for lorries that can hold data on bridge heights and automatically route HGV drivers away from them.

NR has since supplemented detailed information about its bridges to satnav manufacturers to make these systems more accurate, and

Incredible 32 times in the 12-month period preceding its closure to tall road vehicles.

NR has also pledged to encourage the development and trial of new and emerging technologies, such as in-cab low bridge warning devices, and even active brake assist systems that can automatically stop a vehicle without any intervention from the driver.

Intelligent Rail
Our solution would cost no more than £500,000 to put on every bridge, which is very cheap compared to the cost of disruption from bridge strikes.  

Jay Shen, Transreport

Hong Kong and (very soon) Australia. Founded by Shen in September 2016, it started life in his home garage in Coventry while he completed his PhD in Engineering, IoT and Sensor Technology at the University of Warwick.

Shen describes Transreport as ‘a passenger-centric tech company, specialising in IoT and Blockchain technology with a focus on the transport sector’, which is backed by Chinese investors.

With expertise in software programming, data science, engineering, architecture and finance, Shen and his team now believe they have created the perfect system to link NR’s bridge data into Google mapping, while providing a free app to hauliers to enable route planning.

The app provides access to information, such as locations of low bridges across the UK, and an application for drivers to plan risk-reduced routes by inputting vehicle measurements.

The platform is also multi-lingual to cater for foreign drivers who may have trouble reading signs and other information in English, or who struggle to understand imperial units of measurement.

The app alerts the driver when the vehicle is approaching a low bridge, and provides them with real time navigation updates.

Shen says, “Allison and I used to work together at SWR and had kept in touch. She told me about the big problem the rail industry was still having with bridge strikes, and that this could be a really interesting project for us to work on.

“We did our research and read the reports and found it strange that nothing much had been done, despite strikes costing NR £123m a year. Allison and I both thought that with the technology we have, it wouldn’t be hard to come up with a workable solution that we could demonstrate to NR.”

Transreport’s solution relies on small, low-cost, low-powered sensors attached to bridges that provide GPS data on their locations. But that’s not all they can do, with the devices also acting as vibration sensors that could instantly alert NR if a bridge is struck, helping combat the problems of unreported or delayed reporting of strikes.

The sensors can do this by utilising an IoT gateway that connects them to the cloud so that data is securely logged and alerts are immediately sent to NR, drivers and insurers so a sensor detects conditions that exceed a predetermined threshold.

Crucially, the system also appears to be highly cost-effective, with Shen estimating that NR would need to find just £200,000 to fund its development and an initial trial, followed by a further £400,000 to roll it out across its entire network.

“We have software and hardware working together, and the technology is now very mature with a sensor costing just £200, but very accurate and easy to maintain, and with a battery life of up to 12 years,” he adds. “Previously it probably didn’t make sense economically to install technology on bridges, but our solution would cost no more than £501,000 to put on every bridge, which is very cheap compared to the cost of disruption from bridge strikes.”

The next step is for NR to designate a test bridge, for which Dunn and Shen are in negotiations. Installation would be non-disruptive, with no need for possessions to attach the small sensors.

“We would need to put four sensors on a medium-sized bridge so that we can start to gather vibration data and then set parameters to distinguish between trains passing overhead and actual bridge strikes. A one-month trial would be more than enough for us.”

Looking ahead, Shen believes this is not only a good opportunity to eradicate a seemingly persistent problem but also send a strong signal of support to the UK’s fast-growing community of fledgling start-up tech firms.

After all, NR’s procurement strategy for Control Period 6 (April 2019-March 2024) contains bold commitments to provide more support for UK-based SMEs, and to further develop the nation’s home-grown skills base.

“The industry doesn’t have a good image in terms of delays so if you look at this holistically, as a matter of customer satisfaction, then it makes total sense to do this. Also, how often can NR say they are supporting a new tech start-up which is looking at an innovative solution?”

“Huge this gives confidence to other start-ups, because if NR is prepared to give us this chance, then we can give them a new perspective. If you want to solve a problem this big then you probably want to talk to an outsider company, and I hope we can be the inspiration to solve one or two of these problems.”

Should Shen and Transreport make the mark they desire, then perhaps we won’t just be the people of Market Harborough who’ll want to thank him.

Further reading

Bridge strikes: NR strikes back – RAIL 842
Five bridge strikes every day – RAIL 865
Bridges: it’s time for action – RAIL 867
Open Access: RAIL readers have their say – pages 64-67
Throughout the last 200 years, locomotive propulsion technology has proved to be a hotbed of innovation. Ever since the creation of the world's first full-scale railway steam locomotive by British mining engineer Richard Trevithick in 1804, the main line trains have become increasingly faster, energy-efficient and more powerful as the steam age gives way to dieselisation, fuelled by the spread of today’s global network of modern electrified high-speed lines.

More recently, the most significant advances in rolling stock have come in the implementation of intelligent software-based innovations, as the rail industry continues to embrace modern digital technology and the improved connectivity it can offer. Siemens has been at the forefront of this transition, as exemplified by its National Rail Award-winning fleet of Class 700s, currently operated by Govia Thameslink Railway as part of the government-sponsored Thameslink Programme.

As part of Siemens’ Desiro City platform, a total of 1,140 vehicles have been built at the company’s Krefeld manufacturing plant in Germany since 2013. The ‘700s’ are fully digitally enabled, becoming the first main line trains in the world to operate using both Automatic Train Operation (ATO) and ETCS (level 2) in-cab signalling throughout the central Thameslink network.

Meanwhile, the train’s intelligent software design provides fully automatic climate control and a passenger information system that displays real-time main line and London Underground travel information, plus systems are working. We can configure reports on cabin temperatures on Class 700s, for example, and compare that with performance data on the air conditioning system to see if that linkage triggers a set maintenance intervention, such as a fan replacement.

“Intelligent rail also enables dwell time analysis using CCTV-gathered information. The hardware of the train is only designed once, so we can design it to achieve targets in the first instance and then use the data available to refine that and then do what is needed to optimise passenger flows. “The Phase 2 indicative train service specification is for up to 17 trains per hour to arrive at Euston. They will travel at 360kph, which is pushing the boundaries of what we’ve delivered before as an industry to date. You can design for that level of frequency but you can’t necessarily sustain it with continued working and must be able to respond to what the levels of performance are to be delivered.”

Kevin Clark, HS2 Service Bid Manager, Siemens

Our Railigent platform allows us to look at lots of different systems and contextual data at the same time.

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Siemens uses data from the fully digital-enabled Class 700 fleet to improve passenger experience. Govia Thameslink Railway’s Velaro Novo approaches Blackfriars on November 30 2016. JIL BOCKET / RAIL

“We already have lots of data and more and more of it is being generated with every evolution of the train, so the crucial point is in our ability to bring that disparate information together into a single environment so that more informed decisions can be made and appropriate action taken.

“If we think about the last 20 to 30 years, components and systems on trains have become more intelligent but have largely been limited to talking to neighbouring equipment. We can now bring that all together in order to help clients make the right decisions, and to get whole-life value from their assets.”

According to Clark, the benefits to operators of procuring ‘smart’ trains like the Class 700 are manifold in terms of increasing fleet reliability and availability, while also reducing the cost of ownership.

“For example, diagnostic data recorded and transmitted by ETCS in Class 700s has enabled Siemens technicians to increasingly operate in a paperless environment at the depots, where they are equipped with handheld devices rather than the toolkits of old.

“This facility allows them to view relevant performance data, technical information, and view 3D task instructions to quickly identify and remedy any reported faults.

“With more than 20 million miles of service accrued since the first train entered service in June 2015, the Class 700 fleet is progressing through its reliability growth phase, already delivering improved reliability over its predecessor with ambitions to take this much further.

“In order to achieve this, faults and items for improvement are logged and then stored in a database if they have occurred before. They then enter a ‘performance pipeline’ in which remedial action is taken either through hardware or software modification.

“Kevin Clark says that not only will passenger expectations of the new rolling stock be high, but journeys will be required by HS2 Ltd to be seamless, accessible, fast and reliable. He concludes: “One of the key benefits of intelligent rail is that as we as an industry can focus not only on service and operational reliability, but also on how passenger-facing systems are working. We can configure reports on cabin temperatures on Class 700s, for example, and compare that with performance data on the air conditioning system to see if that linkage triggers a set maintenance intervention, such as a fan replacement. Intelligent rail also enables dwell time analysis using CCTV-gathered information. The hardware of the train is only designed once, so we can design it to achieve targets in the first instance and then use the data available to refine that and then do what is needed to optimise passenger flows.”

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Kevin Clark, HS2 Service Bid Manager, Siemens
3Squared has taken an innovative approach to mitigating the perennial problem of ‘leaves on the line’

E
ach and every autumn the rail industry resumes its annual battle with leaves on the line. According to Network Rail, approximately 500,000 leaves fall onto its metals each year, where they can then be compressed by passing trains into a smooth, slippery layer.

The low adhesion that results from this problem means that trains need more time to stop and start in order to avoid wheel spin and overshooting platforms or signals — in much the same way that a car can be affected by black ice.

What’s more, by interrupting the connection between track and train wheel, fallen leaves can cause the electrical track circuits needed for signalling systems to become less accurate. Aside from the obvious safety risk to passengers, leaf fall results in more than a few hiccups.

Reduced timetables are often required and trains are sometimes taken out of service at short notice if they incur wheel flats — all significant extra costs to operators.

There are a number of ways to partially mitigate the impact of leaf fall, however, with NR employing a comprehensive year-round vegetation management programme. Meanwhile, from early October to early December, a fleet of over 50 specialist railhead treatment trains are deployed on affected routes to blast away the fallen vegetation with water jets, and then apply a sand-based gel to further improve wheel grip.

Although it is the effects of leaf fall that gains the most attention from both the media and wider travelling public, it isn’t just in the autumn that low adhesion can occur, and it is often forgotten that railroad contamination can occur at any time of year from rust and grease. Snow and ice can also decrease adhesion levels in periods of low temperature, as can light drizzle after a long, dry period, or even morning dew.

In response to this adhesion challenge, award-winning technology consultancy 3Squared has stepped forward to develop an innovative digital solution, in conjunction with the Met Office and Colas.

The consortium’s ADS (Adhesion Digital Solution) works by managing, coordinating and then disseminating real-time adhesion information.

Data from the Met Office’s existing low-adhesion forecasting model is combined with ADS with cross-referenced driver-reported data on actual railhead conditions to give operators detailed, up-to-the-minute, route-based adhesion forecasts.

ADS provides this high-resolution and route-specific risk data to drivers via an app uploaded to a tablet device mounted in the cab so that informed decisions can then be made on train regulation that helps reduce safety risk and the likelihood of accidents.

Drivers are then able to report wheel slippage through the app, providing a warning to others in real time.

3Squared’s Commercial Director James Fox explains: “This collaborative project takes a dramatically different and innovative, data-driven approach to solving a problem that continues to cause significant disruption on the UK network.

“We found that Colas was experiencing some big problems with wheel slip on heavy freight trains on some routes, the Met Office was keen to provide a more accurate forecasting tool, while we had the technological expertise - it was the perfect time to come up with a solution.”

The funding to develop ADS from concept to delivery has come through the rail standards body RSSB’s TOC17 competition to identify projects that will improve operational performance.

3Squared has led the consortium developing ADS by providing project management, software development and systems integration expertise, while the Met Office has supplied its specialist data and Colas has tested the product on some of its services.

Fox adds: “We found that Colas was already being provided with a basic adhesion forecast by Network Rail, but it was vague and not particularly up-to-date or route-specific, so we thought we’d collaborate with the Met Office and the operator to provide a more accurate tool.

“The TOC17 competition was there and was a good fit, and it has really helped accelerate the development of the project. The trial with Colas over the autumn went really well - we’ve learned some valuable lessons and made further improvements, and now some other operators are keen to roll it out this autumn.”

3Squared was in the process of compiling statistical information for RSSB on the exact operational benefits achieved by the trial as this issue of RAIL went to press, but Fox’s attention has already moved to several other promising future applications of ADS.

He also points to the strong collaborative nature of the ADS programme, upon which 3Squared has prided itself since its formation in 2002.

It has been the formation of similarly close partnerships with other clients that has underpinned the company’s rapid growth from a small two-man digital and creative agency based in Sheffield, to one of the rail sector’s leading software solutions providers.

For example, 3Squared’s collaboration with Stagecoach-owned train operating companies East Midlands Trains and South West Trains, plus freight operating company GB Railfreight, yielded the first of its flagship RailSmart EDS (employee development system), that earned 3Squared a Queen’s Award for Innovation (RAIL, 9/16).

Meanwhile, in addition to ADS, 3Squared is also working closely with RSSB on an innovative software solution that helps improve disabled access to the railway, as part of RSSB’s Rail Accessibility Challenge.

Fox concludes: “ADS has huge potential and we have people currently looking at sanders [train-mounted sandboxes that drop sand in front of the driving wheels to increase traction in wet and slippery conditions] where we could potentially link our software to operators’ hardware in order to link automatically with these trains.

“Although it is also the potential to integrate the software with train-mounted cameras so that the Met Office can corroborate the data they currently provide, and subsequently increase the accuracy of its forecasting.

“ADS is still at an early stage of commercialisation, but the product’s future looks very bright, and it is yet another example of the 3Squared mantra that we have ‘collaboration in our DNA’.”

This collaborative project takes a dramatically different and innovative, data-driven approach.

James Fox, Commercial Director, 3Squared

 mash up the data to create a map that shows which areas the trains are running through and how they are slipping.

The map can help operators identify where they need to focus their efforts to mitigate the effects of leaf fall, enabling them to make more informed decisions about when and where to deploy treatment trains.

With ADS, Network Rail, Colas and operators can work together to reduce the impact of leaf fall on adhesion levels, improving safety and reliability for passengers and freight.

3Squared was proud to be shortlisted for an award from the industry’s leading software solutions provider, RSSB, for its collaborative work on this project.
CrossCountry is using a new smart communications suite developed by Nexus Alpha that promises to transform the provision of information to staff and passengers. ANDREW RODEN explores the potential of Arrakis

These days, virtually any technological innovation – particularly when it comes to software - is heralded as a game-changer. But a new system developed by Nexus Alpha and being deployed by CrossCountry just may justify the term. Called Arrakis, its bold aim is to transform the way that information is collected and disseminated to railway staff and customers alike.

Nexus Alpha’s Tyndall I3 control room system is widely used in the railway, and its data on incidents and train running is kept up to date and anonymous. However, as CrossCountry Duty Control Manager Mart Reeves tells RAIL: “We have a number of products that provide information. The problem is that there’s often multiple incidents that arrive as a result, and the information provided to staff - particularly train crews. At times, they can’t see the wood for the trees.”

This is what Arrakis aims to solve. It draws information from across the railway (including Tyndall I3 and the Darwin customer information system) and then, crucially, tailors that information to staff’s specific needs.

So, while currently a CrossCountry train manager may receive information affecting the operator’s entire network, Arrakis enables much greater personalisation of that information.

Using a mobile application, staff can enter details of the trains they are working on a given day, and select what sort of information they wish to be alerted about. This could include information about other operators on the train’s route, details of punctuality of connecting trains, problems at stations, and so on. The aim is to provide staff with relevant information and avoid overload, giving them more time to serve passengers.

Reeves explains: “It isn’t just about our own trains - it can alert about other operators’ services. That means we can give passengers better information about their journey - if staff have better information, then so do passengers.”

Arrakis has long been in development by Nexus Alpha, whose pedigree in the railway railway business dates back to the 1990s. And following CrossCountry’s Direct Award extension in 2017, the operator’s requirement to provide better customer information synchronised neatly with the system’s development.

In its initial form it will provide onboard staff with: control room information; enhanced staff live departure boards; cancellation, part-cancellation and significant lateness status; and ‘rainbow boards’ which provide a colour-coded view of how different routes are performing, and multi-TOC cancellation and significant lateness disruption. It began rolling out last summer.

However, while providing better information to railway staff and passengers is a laudable aim, the potential of Arrakis is much, much bigger. Because it has been designed ‘from the ground up’ to be a modular system, additional elements can be added easily and then tailored to the specific needs of staff.

One exciting possibility highlighted by Nexus Alpha is the provision of travel assistance – an area which the Office of Rail and Road is eager for the rail industry to improve.

When a passenger makes a request for travel assistance, Arrakis can allow staff to input the passenger’s details and their specific needs, and then disseminate it to station staff. The details are received via an alert, to which staff can respond to accept the assistance request. This is relaid to the passenger, who can then request help not only that assistance will be available, but that a specific member of staff will be helping them. It can also even be used on multi-leg journeys, so that at every point the passenger knows who will be assisting them.

This is made possible by the targeted nature of Arrakis information, meaning that assistance requests at (for example) East Croydon would only go to staff there, with requests for the end of the journey at London Victoria only being sent to staff at that station.

If providing better information and assisted travel were the limits of Arrakis’ capability, it would make a major step forward, but the potential is greater still. It would be perfectly possible for onboard staff to report incidents on their journey in real-time, with photographs if required, to enable Control Room staff to make more informed decisions.

In the case of a broken window, that ability to report and send images would mean a decision could be taken about whether to take the train out of service at the first opportunity, or to continue to its final destination. Admittedly, staff can do this already and send a message to control, but using Arrakis would mean that subscribers to such information would also automatically be informed.

Arrakis can also provide analysis of train running and trends. Again, while some of the data is already in the railway systems, bringing it together makes it possible to identify issues and resolve them much more quickly. (Arrakis holds data associated with 300,000 route incidents already).

Consistently late departures from a station where catering supplies are loaded could be due to the time being taken on that task. But what if, on certain trains, it is simply greater numbers of passengers boarding and alighting? Or what if time is consistently lost on a specific section of track due to train regulation?

By pulling together multiple data sources, Arrakis can highlight potential issues and enable train operators to find a solution. And as more train running and operational data is added to the system, its machine learning algorithms mean it can provide ever more precise insight into operational issues.

Fares data could be added to the system to provide cues about expected heavy loadings at stations, feeding back into timetable planning - or even, potentially, the likes of advance fans to be changed to manage demand. It can even generate real-time feedback feeds as a Twitter to identify customer sentiment and spot trends.

In the future, it is entirely possible that passengers could effectively use a version of the Arrakis interface tailored to their journeys with alerts about connecting trains and other transport modes, with integration from Traveline and data from bus real-time providers. Its potential is only limited by the data fed into the system. It is this modular approach and flexibility which makes it so powerful.

Naturally, Nexus Alpha believes it has a winner on its hands, but so does CrossCountry. “I think it’ll be a game changer,” says Reeves. “Providing more information to passengers can only be a good thing.”

At a time when the rail industry is under sustained fire for its provision of passenger information, it is hard to argue with his sentiment. Arrakis may just be the tool that the railway, staff and passengers have been wanting for decades. For hard-pressed passengers wondering what is going on at times of disruption, the wider rollout of such a tool cannot come soon enough.

ABOUT THE AUTHOR

Andrew Roden is a railway journalist, author, radio presenter and commentator. A Riley News and Features writer from 1995 to 2018, Andrew now runs the website of four major railway books, and is a regular commentator on television and radio on rail matters in the South West.

Andrew Roden, Contributing Writer
I’ve been almost a year since the official launch of the UK Railway Research and Innovation Network (UKRRIN) at the House of Lords on February 20 2018. Designed to create a powerful collaboration between academia and industry, UKRRIN brings together eight universities with 15 industry partners in order to drive innovation and initiate a systems-wide approach to enhancing the railway.

These universities have joined forces and combined their resources to form three Centres of Excellence – in Digital Systems (University of Birmingham), Rolling Stock (University of Huddersfield, Newcastle University and Loughborough University) and Infrastructure (University of Nottingham, University of Southampton, Loughborough University, University of Sheffield and Heriot-Watt University). Meanwhile, a fourth Centre of Excellence has been created with a focus on Testing, which incorporates facilities at Network Rail’s Birmingham Centre of Railway Research and Education (BCRRE) is now clearly at the forefront of thought-leadership and technological prowess in the railway domain.

BCRRE is investigating fundamental questions about the use of electronic information in the transport domain. Working alongside the security and privacy group from the School of Computer Science, an NCSC Centre of Academic Excellence in the field, BCRRE’s security work is focused on the Operational Technology (OT) elements of the railway. Recent project work has included formal analysis of the ERTMS train to trackside communication protocols, and the development of TRAKS, a post-quantum secure key management scheme for ERTMS.

The team is also part of the Research Institute in Trustworthy Interconnected Cyberphysical Systems (RITICS), led by Imperial College, and in this context has recently started work on an assessment of the implications of the EU NIS directive on the GB rail supply chain. The four Centres of Excellence are currently benefiting from more than £90 million of investment in developing their research facilities, comprising £21m awarded by the Higher Education Funding Council for England and £64m from industry. All sites are due to be completed by 2020.

These world-leading facilities will be open to UKRRIN industry members from the railway supply chain so that research and development projects can be carried out more quickly from the early design stage to full commercialisation. In turn, university researchers and students will have improved access to industry experts and real-life projects, helping to expand their skill sets and augment their employability. It is hoped that this link-up will not only boost innovation, productivity and the export strength of the UK rail sector, but also make the industry a more attractive place for the next generation of talent to base their skills.

Furthermore, the DIGI-RAIL project (funded by the European Regional Development Fund) will help develop a unique Digital Railway demonstrator platform that brings together national and international railway industry buyers with West Midlands businesses. It will provide research expertise to solve industry challenges and to develop digital products and services for the rail industry. The UK expects an efficient, reliable rail system, and DIGI-RAIL will have a key role in developing new technology for the UK’s network’s Centre of Excellence in Digital Systems (CEDS).

Based at the University of Birmingham and led by Professor Clive Roberts, the CEDS will enable advanced data processing that can be the means to translate raw data into meaningful insight with real business value. DIGI-RAIL will be the first to cross-link the digital data feeds and real-time data to exploit the opportunities in the rail industry in the real world, BCRRE has long been involved in world-leading simulation research, which in natural partnership with a Digital Twin will help deliver the next generation of railway traffic management and control systems. Dr Gemma Nicholson, the Research Fellow who is leading this project alongside Professor Roberts, adds: “There is a tremendous scope for railway Digital Twin technologies. The Digital Twin will be the means to translate raw data into meaningful insight with real business value by allowing high-level analysis and the ability to see opportunities or problems before they occur in the real world.”

BCRRE has recently signed a Memorandum of Understanding with the rail vehicle maker Porterbrook to convert a Class 319 electric multiple unit into a hydrogen-powered train, called ‘HydroFlex’.

Delegates at UKRRIN’s inaugural annual conference, held in central London on November 13, heard from Professor Roberts about CEDS’ scheduled opening in mid-2020, and on how procurement has already started for equipment, including train cab simulators, data platforms, 3D visualisation technology, and signalling and communication equipment.

He said: “These will be facilities for all, not just BCRRE. They will help us to a number of grand challenges as an industry in the next few years, including ensuring system-wide cyber security and achieving zero on-site testing for railway equipment.”

As part of its UKRRIN membership, a number of new initiatives are also currently underway at BCRRE, including the hosting of the University Innovation Day by Siemens and two Network Rail engineering conferences and two Digital Railway Delivery differently events. It is also leading the DIGI-RAIL business support and demonstrator programme (see panel) to assist more than 50 small and medium-sized enterprises (SMEs) to exploit the opportunities created by NFI’s Digital Railway Programme.

As part of BCRRE’s contribution to the Government’s Rail Sector Deal, it is extending existing plans for a Rail Industry Data Platform (initially intended to provide data crucial to RAIL Delivery within the UK Rail Research and Innovation Network) to include the wider rail industry. BCRRE’s Professor Clive Roberts, Dr John Easton and Dr Lei Chen will combine their extensive expertise to ensure that the first full-release version is available from spring 2020.

“Currently it is difficult to understand the wider systems context of industry problems with any degree of confidence,” says Easton, a lecturer in Computer Systems from the School of Engineering.

“The data platform will mean that rather than having access to just one or two datasets in isolation, we will have a range of data available that will allow us to look at the problem from several different angles.”

Alongside the data platform, BCRRE will lead in the design of a cutting-edge Digital Twin, a fully functional digital replica of the railway that is intended to drive innovation by allowing high-level analysis and the ability to see opportunities or problems before they occur in the real world.

An artist’s impression of the new 3,000m² building due to open at the University of Birmingham in spring 2020 to house BCRRE’s Centre of Excellence in Digital Systems, UKRRIN.

BCRRE’s Professor Clive Roberts was delivering a presentation about BCRRE’s role in the UKRRIN Centre of Excellence in Digital Systems at the University of Birmingham on April 9. Visit www.birmingham.ac.uk/railway for more details and to register.

Alternatively, contact BCRRE by emailing railway@contacts.bham.ac.uk or by following @bcurre.

FURTHER READING
University Challenge – RAIL 837
Innovation Central – RAIL 835
The Innovation Game – RAIL 867
Tbe Rail Sector Deal launched on December 6 2018 announced a ‘new approach’ to collaborative working between the Government and the rail industry. About time, you might think - especially as Acting Chairman of the RSG’s SME Group. JOSEPH INFANTE, CPC Partner, Transport & Infrastructure and Acting Chairman of the Rail Supply Group’s SME Group, says small and medium-sized enterprises can be a huge asset for the rail industry.

More spending through SMEs is the surest way to free access data. Free the data and the apps will follow. The promised open data sharing platform is given as a priority, and we must make sure that it stays one. Data is the lifeblood of any digital system, and if we are going to find new ways to create a sustainable and environmentally responsible rail system we are going to need more and better data all the time. We have the talent to lead the world in digital rail, provided the necessary data is made available and that we have the right level of investment in the right places. But we must not let the moment pass and slip back into the habits of mind and working practices that have stood in the way of innovation in the past.

As anyone with experience of working as a small business in rail will tell you, we have too often competed with the odds stacked against us because of opaque and poorly thought-out procurement procedures. The resources required to respond to a two-week deadline to tender for a major project, followed by what often seems like an indefinite wait for the verdict, are not easily available to many SMEs. It is encouraging that the Rail Sector Deal promises improvements in procurement practice, but it is essential that this is more than lip service. We need to see huge improvements in transparency and in planning - more notice, more clarity and more collaboration.

A proper strategic approach to project planning that gets away from the boom and bust of previous investment rounds would allow earlier engagement with industry, and give the SME supply chain a chance to influence what is procured. Better specifications mean better bids that are more innovative, up-skilling through structured training, local employment and productivity. In the Rail Sector Deal, the Government is committed to a minimum 33% spend on SMEs across all departments. That will make a reality in rail when the processes make it practical for SMEs to compete, but we will only know it has been achieved when we finally start to measure it in a fair and transparent way.

Alarmingly, there are still no firm plans to create such a measure. And the truth is that as things stand, we don’t really have much of an idea what percentage of the Government’s rail investment actually goes to the SME sector. Anyone who knows the sector well will tell you that it is often less than it seems. Too often the SME involvement, in a major tender managed by a Tier 1 contractor, ends when the bid is submitted. In some cases, what looks like collaboration on paper may not translate into work when it really matters.

The Rail Sector Deal makes a lot of the right noises about these issues. We hope that the Keith Williams root-and-branch review of UK rail that reports at the end of 2019 will add some muscle. If the Government gets it right, it could unlock the potential of the SME sector to address policy challenges that our bigger, more centralised and less agile competitors can’t meet alone. SMEs are regional, spread widely across the country. We have local knowledge and relationships, and are flexible and quick to respond. We can create employment in the regions, and find and develop skills in places that the big organisations can’t easily match. This is good for the country and good for the rail sector, bringing skills and ideas to work that would otherwise be wasted.

The new year is in its infancy, and the post-Brexit world is looming ever larger - with all its terrors or opportunities, depending on your point of view. Uncertainty, it seems, is all around. But one thing is sure: whatever happens the future will be digital. We don’t yet know what the tech will look like, we don’t know how it will be used, but we are going to have to build it.

As the next wave of rail investment approaches with the arrival of the five-year spending round of Control Period 6, we can expect a sudden rush of excitement and project procurement. Let’s hope that this round, in keeping with the ambition and vision of the Rail Sector Deal, is different… that the government gets it right, and finally unleashes the power of the SMEs. It’s the only way that the digital future our rail deserves can be made to happen.

WAKING THE SLEEPING GIANT

SMEs will be the key to fulfilling the ambitions of the Rail Sector Deal, including driving innovation and upskilling the industry workforce in Control Period 6, says Joseph Infante, Acting Chairman of the RSG’s SME Group.
Urbanisation, population growth and the continuously changing socio-economic landscape have led transport planners around the world to work towards integrated transport systems, in which the railway plays a key part. Commuting is linked to economic growth and has an impact on both work and social life. Despite investment in new railway infrastructure, the challenge remains of trying to design and build infrastructure that is more intuitive for passengers and reducing stress levels. This will allow the controller to improve the passenger experience and reduce operation and maintenance costs.

The concept of smart rail infrastructure is developing quickly, boosted by innovation in technology, to help in reducing lifecycle costs and increasing asset reliability during operation. Advanced data-analytic tools and the innovative ‘Internet of Things’ (IoT) technology are being used to monitor assets’ conditions and data is being used to monitor assets’ maintenance access remain a challenge for accelerating effect on asset degradation.

For the train journey itself, progress is being made in terms of more frequent train services and shorter journey times. Infrastructure and technology have played an unseen role in enabling these improvements, including bridge strengthening, track alignment improvement, longer trains and platforms, and signalling upgrades to improve capacity and reduce journey time. Combining modern digital technology (such as ETCS, TMS) with infrastructure alterations enables trains to run closer together (creating paths for more services) and faster (to improve journey times). To the passenger this means more flexibility over when they can travel, less time waiting for the train and less time spent getting to their destination.

The passenger experience is determined not only by the speed and frequency of the train service but also by reliability that can be achieved. Providing reliable and dependable transport means not only designing and building assets to the required standards but also keeping them in a maintainable condition.

While the assets are getting older and mobility needs are increasing, there is an accelerating effect on asset degradation. As operational constraints and limited maintenance access remain a challenge for asset management, use of digital technologies and data is being used to monitor assets’ actual condition in real time. The concept of smart rail infrastructure is developing quickly, boosted by innovation from the Internet of Things (IoT) and sensor technology. Obtaining data from physical assets and the asset management system can provide valuable data to help in reducing lifecycle costs and increasing asset reliability during operation. During the actual journey, establishing what is most important to passengers is crucial to ensuring their satisfaction. For the train service to operate on time, the service package includes features such as seat-finding, on-board catering, power sockets/VoIP, luggage space and so on, the relative importance of which vary according to the type of journey and the individual. Customer feedback and data will help to make sure the right service packages are provided.

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Creating better journeys

We deliver innovative and versatile asset management, engineering design and operational solutions to Network Rail, Transport for London, train operating companies, passenger transport executives and other rail providers.

Through standalone provision and selected joint ventures and alliances we’re helping to enhance performance and efficiency for our customers to improve service levels for the public.